(3) The temperature of the gas flowing in the heated sample line before the heated filter, and also before the HFID, and the temperature of the control system of the heated hydrocarbon detector.

(4) Gas meter or flow measurement instrumentation readings at the start of each sample period and at the end of each sample period.

(5) The stabilized pre-test weight and post-test weight of each particulate sample and back-up filter.

(6) Continuous temperature and humidity recording of the ambient air in which the particulate filters were stabilized.

(p) *Additional required records for methanol-fueled vehicles.* (1) Specification of the methanol-fuel or methanol-fuel mixtures used during the test.

(2) Volume of sample passed through the methanol sampling system and the volume of deionized water in each impinger.

(3) The concentration of the GC analyses of the test samples (methanol).

(4) Volume of sample passed through the formaldehyde sampling system and the volume of DNPH solution used.

(5) The concentration of the HPLC analysis of the test sample (formaldehyde).

(6) The temperatures of the sample lines before the HFID and the impinger, the temperature of the exhaust transfer duct (as applicable), and the temperature of the control system of the heated hydrocarbon detector.

(7) A continuous measurement of the dew point of the raw and diluted exhaust. This requirement may be omitted if the temperatures of all heated lines are kept above 220 °F, or if the manufacturer performs an engineering analysis demonstrating that the temperature of the heated systems remains above the maximum dew point of the gas stream throughout the course of the test.

(q) *Additional required records for natural gas-fueled vehicles.* Composition, including all carbon containing compounds; e.g. CO_2, of the natural gas-fuel used during the test. C_1 and C_2 compounds shall be individually reported. C_3 and heavier hydrocarbons, and C_6 and heavier compounds may be reported as a group.

(r) *Additional required records for liquefied petroleum gas-fueled vehicles.* Composition of the liquefied petroleum gas-fuel used during the test. Each hydrocarbon compound present, through C_4 compounds, shall be individually reported. C_5 and heavier hydrocarbons may be reported as a group.

[54 FR 14533, Apr. 11, 1989, as amended at 58 FR 58422, Nov. 1, 1993; 59 FR 48510, Sept. 21, 1994; 60 FR 34348, June 30, 1995; 79 FR 23697, Apr. 28, 2014]

§ 86.143–96 Calculations; evaporative emissions.

(a) The following equations are used to calculate the evaporative emissions from gasoline- and methanol-fueled vehicles, and for gaseous-fueled vehicles.

(b) Use the measurements of initial and final concentrations to determine the mass of hydrocarbons and methanol emitted. For testing with pure gasoline, methanol emissions are assumed to be zero.

(1) For enclosure testing of diurnal, hot soak, and running loss emissions:

(i) Methanol emissions:

$$M_{CH_3OH} = V_n \times \left[\frac{(C_{MS1f} \times AV_{1f}) + (C_{MS2f} \times AV_{2f})}{V_{E_f}}\right] - \left[\frac{(C_{MS1i} \times AV_{1i}) + (C_{MS2i} \times AV_{2i})}{V_{E_i}}\right] + \left(M_{CH_3OH,out} - M_{CH_3OH,in}\right)$$

Where:

(A) M_{CH3OH} = Methanol mass change, µg.

(B) V_n = Net enclosure volume, ft^3, as determined by subtracting 50 ft^3 (1.42 m^3) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50 ft^3) with advance approval by the Administrator: *Provided*, the measured volume is determined and used for all vehicles tested by that manufacturer.

(C) [Reserved]

(D) V_E = Volume of sample withdrawn, ft^3. Sample volumes must be corrected for

differences in temperature to be consistent with determination of V_n, prior to being used in the equation.
(E) [Reserved]
(F) C_{MS} = GC concentration of sample, μg/ml.
(G) AV = Volume of absorbing reagent in impinger.
(H) P_B = Barometric pressure at time of sampling, in. Hg.
(I) i = Initial sample.
(J) f = Final sample.
(K) 1 = First impinger.
(L) 2 = Second impinger.
(M) $M_{CH3OH,\ out}$ = mass of methanol exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, μg.
(N) $M_{CH3OH,\ in}$ = mass of methanol entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, μg.

(ii) Hydrocarbon emissions:

$$M_{HC} = \left(kV_n \times 10^{-4}\right) \times \left(\frac{\left(C_{HC_f} - rC_{CH_3OH_f}\right)P_{B_f}}{T_f} - \frac{\left(C_{HC_i} - rC_{CH_3OH_i}\right)P_{B_i}}{T_i} \right) + M_{HC,out} - M_{HC,in}$$

Where,
(A) M_{HC} = Hydrocarbon mass change, g.
(B) C_{HC} = FID hydrocarbon concentration as ppm including FID response to methanol (or methane, as appropriate) in the sample.
(C) C_{CH3OH} = Methanol concentration as ppm carbon.

$$= \frac{1.501 \times 10^{-3} \times T}{P_B \times V_E} \times \left[\left(C_{SI} \times AV_1\right) + \left(C_{S2} \times AV_2\right)\right]$$

(D) V_n = Net enclosure volume ft^3 (m^3) as determined by subtracting 50 ft^3 (1.42 m^3) (volume of vehicle with trunk and windows open) from the enclosure volume. A manufacturer may use the measured volume of the vehicle (instead of the nominal 50 ft^3) with advance approval by the Administrator, provided the measured volume is determined and used for all vehicles tested by that manufacturer.
(E) r=FID response factor to methanol.
(F) P_B = Barometric pressure, in Hg (Kpa).
(G) T=Enclosure temperature, °R(°K).
(H) i=initial reading.
(I) f=final reading.
(J) 1=First impinger.
(K) 2=Second impinger.
(L) Assuming a hydrogen to carbon ratio of 2.3:
(*1*) k=2.97; and
(*2*) For SI units, k=17.16.
(M) $M_{HC,\ out}$ = mass of hydrocarbons exiting the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.
(N) $M_{HC,\ in}$ = mass of hydrocarbons entering the enclosure, in the case of fixed-volume enclosures for diurnal emission testing, g.

(iii) For variable-volume enclosures, defined in § 86.107(a)(1)(i), the following simplified form of the hydrocarbon mass change equation may be used:

$$M_{HC} = \left(\frac{kP_B V_n \times 10^{-4}}{T} \right) \times \left[\left(C_{HC_f} - rC_{CH_3OH_f}\right) - \left(C_{HC_i} - rC_{CH_3OH_i}\right)\right]$$

(2) For running loss testing by the point-source method, the mass emissions of each test phase are calculated below, then summed for a total mass emission for the running loss test. If emissions are continuously sampled, the following equations can be used in integral form.

(i) Methanol emissions:

$M_{CH_3OH} = \rho_{CH_3OH} V_{mix} \times (C_{CH_3OH,\ rl} - C_{CH_3OH,\ d})$

Where,

(A) M_{CH_3OH} = methanol mass change, μg.

(B) $\rho_{CH_3,OH}$ = 37.71 g/ft³, density of pure vapor at 68 °F.

(C) V_{mix} = total dilute sample volume, in ft³, calculated as appropriate for the collection technique used.

(D) $C_{CH_3OH,\ rl}$ = methanol concentration of diluted running loss sample, in ppm carbon equivalent.

(E) $C_{CH_3OH,\ d}$ = methanol concentration of dilution air, in ppm carbon equivalent.

(ii) Hydrocarbon emissions:

$M_{HC} = \rho_{HC} V_{mix} 10^{-6} \times (C_{HC,\ rl} - C_{HC,\ d})$

Where,

(A) M_{HC} = hydrocarbon mass change, g.

(B) ρ_{HC} = 16.88 g/ft³, density of pure vapor at 68 °F (for hydrogen to carbon ratio of 2.3).

(C) V_{mix} = total dilute sample volume, in ft³, calculated as appropriate for the collection technique used.

(D) $C_{HC,\ rl}$ = hydrocarbon concentration of diluted running loss sample, in ppm carbon equivalent.

(E) $C_{HC,\ d}$ = hydrocarbon concentration of dilution air, in ppm carbon equivalent.

(c) If the test fuel contains at least 25% oxygenated compounds by volume, measure the concentration of oxygenated compounds directly using a photoacoustic analyzer specified in 40 CFR 1065.269 or using impingers as described in 40 CFR 1065.805(f). Calculate total hydrocarbon equivalent emissions with the following equation, using density values specified in 40 CFR 1066.1005(f):

$$m_{\mathrm{THCE}} = m_{\mathrm{THC}} + \rho_{\mathrm{THC}} \cdot \sum_{i=1}^{N} \frac{m_{\mathrm{OHCi}}}{\rho_{\mathrm{OHCi}}} \cdot \left(1 - RF_{\mathrm{OHCi[THC\text{-}FID]}}\right)$$

Where:

m_{THCE} = the sum of the mass of THCE in the SHED.

m_{THC} = the mass of THC and all oxygenated hydrocarbons in the SHED, as measured by the FID. Calculate THC mass based on ρ_{THC}.

ρ_{THC} = the effective C_1-equivalent density of THC as specified in 40 CFR 1066.1005(f).

m_{OHCi} = the mass of oxygenated species *i* in the SHED.

ρ_{OHCi} = the C_1-equivalent density of oxygenated species *i*.

$RF_{OHCi[THC–FID]}$ = the response factor of a THC–FID to oxygenated species *i* relative to propane on a C_1-equivalent basis as determined in 40 CFR 1065.845.

(d)(1) For the full three-diurnal test sequence, there are two final results to report:

(i) The sum of the adjusted total mass emissions for the diurnal and hot soak tests ($M_{DI}+M_{HS}$); and

(ii) The adjusted total mass emissions for the running loss test, on a grams per mile basis=M_{RL}/D_{RL}, where D_{RL} = miles driven for the running loss test (see § 86.134–96(c)(6)).

(2) For the supplemental two-diurnal test sequence, there is one final result to report: the sum of the adjusted total mass emissions for the diurnal and hot soak tests ($M_{DI}+M_{HS}$), described in §§ 86.133–96(p) and 86.138–96(k), respectively.

[58 FR 16043, Mar. 24, 1993, as amended at 59 FR 48510, Sept. 21, 1994; 60 FR 34348, June 30, 1995; 60 FR 43897, Aug. 23, 1995; 79 FR 23698, Apr. 28, 2014]

§ 86.144–94 Calculations; exhaust emissions.

The final reported test results shall be computed by use of the following formula:

(a) For light-duty vehicles and light duty trucks:

$$Y_{wm} = 0.43\left(\frac{(Y_{ct} + Y_s)}{(D_{ct} + D_s)}\right) + 0.57\left(\frac{(Y_{ht} + Y_s)}{(D_{ht} + D_s)}\right)$$